

## CLAIMS

### THAT CLAIMED IS:

1. An improved pressure relief valve having a housing with a relief passage, a valve seat therein, and a pressure chamber, a movable valve member in the housing that is movable from a closed position to an open position in response to a system pressure increase, a movable pressure barrier carried in the pressure chamber and operably connected to the valve member, wherein the improvement comprises:

a stationary fluid injector stab extending through a side of the pressure chamber and sealingly engaging a central bore of the movable valve member for delivering pressurized fluid;

a stab port extending through a sidewall of the injector stab for flowing the fluid into the pressure chamber on a first side of the pressure barrier; and

a valve member port extending through a side of the valve member, the valve member port being in fluid communication with the stab port when the valve member is in its open position so that the pressurized fluid flows into the pressure chamber on a second side of the pressure barrier, the valve member port being sealed from the stab port when the valve member is in its closed position and venting while the valve member is approaching its closed position for the fluid on the second side of the pressure barrier to exit the chamber.

2. The improved pressure relief valve of claim 1, wherein the stab port comprises:

a first stab port located adjacent the portion of the injector stab that sealingly engages the central bore of the valve member; and

a second stab port spaced axially from the first stab port relative to an axis of the injector stab.

3. The improved pressure relief valve of claim 2, wherein the first stab port transmits the pressurized fluid to the pressure chamber on the second side of the pressure barrier after the valve member moves from the closed position.
4. The improved pressure relief valve of claim 2, wherein the second stab port always communicates with the pressure chamber on the first side of the pressure barrier.
5. The improved pressure relief valve of claim 2, wherein the first stab port communicates with the pressure chamber on the first side of the pressure barrier when valve member is in the closed position.
6. The improved pressure relief valve of claim 1, further comprising a venting port through a side wall of the valve member, the venting port being sealed from the pressure chamber on the second side of the pressure barrier when the valve member is in the open position, and being in fluid communication with the pressure chamber on the second side of the pressure barrier as the valve member is approaches the closed position.
7. The improved pressure relief valve of claim 1, further comprising a barrier outlet port associated with the pressure chamber on the second side of the pressure barrier for transmitting the pressurized fluid from the pressure chamber on the second side of the pressure barrier to the pressure chamber on the first side of the pressure barrier when the valve member and pressure barrier begin moving from the open position to the closed position.

8. The improved pressure relief valve of claim 1, further comprising a seal located adjacent the stab port, the seal engages the bore of the valve member between the stab port and the valve member port and thereby preventing the pressurized fluid from entering the pressure chamber on the second side of the pressure barrier when the valve member is in the closed position.

9. The improved pressure relief valve of claim 1, further comprising a venting port through a side wall of the valve member for venting the pressurized fluid flowing through the valve member port to atmosphere when the valve member is approaching its closed position.

10. An improved pressure relief valve, comprising:

a housing with a relief passage, a valve seat therein, and a pressure chamber;

a movable valve member in the housing, which is movable from a closed position to an open position, the valve member engaging the valve seat in the closed position to block flow through the relief passage, the valve member moving away from the valve seat in the open position to allow flow through the relief passage while the pressure in the system is sufficiently high;

a movable pressure barrier carried in the pressure chamber, defining first and second sides of the pressure chamber, and operably connected to the valve member for movement therewith;

a fluid injector stab stationarily extending through the first side of the pressure chamber and having a seal sealingly engaging a central bore of the movable valve member;

a stab port extending through a side wall of the injector stab on a first side of the seal to communicate pressurized fluid into the first side of the chamber when the valve member is in the closed position;

a valve member port extending from the central bore to the second side of pressure chamber to supply pressurized fluid from the stab port to the second side of the pressure chamber when the valve member moves the valve member port above the seal; and

a vent port in the valve member that extends from the central bore to atmosphere for venting pressurized fluid for the second side of the pressure chamber when the valve member moves the valve member port below the seal.

11. The improved pressure relief valve of claim 10, further comprising a second stab port spaced above the first mentioned stab port for continuous communication with the first side of the pressure chamber.

12. The improved pressure relief valve of claim 10, wherein the fluid injector stab extends from an upper side of the pressure chamber toward the valve member.

13. The improved pressure relief valve of claim 10, further comprising an annular space between the central bore and the stab above the seal.

14. The improved pressure relief valve of claim 10, wherein the valve member port is continuously in communication with the second side of the pressure chamber.

15. A method of relieving a pressure of a system fluid in a pressurized system line having a valve having a housing with a relief passage, a valve seat, and a pressure chamber therein, the method comprising the steps of:

(a) disposing a movable valve member within the housing, and stationarily mounting an

injector stab within a tubular portion of the valve member;

(b) operably connecting the valve member to a pressure barrier disposed in the pressure chamber;

(c) injecting a pressurized fluid through the injector stab into the pressure chamber on a first side of the pressure barrier, thereby creating a biasing force against the first side of the pressure barrier, urging the valve member to the closed position;

(d) exposing the valve member to the system fluid and applying system fluid pressure to open the valve member when the pressure of the system fluid is sufficiently high to overcome the pressure of the fluid in the pressure chamber on the first side of the pressure barrier, allowing flow through the relief passage; then

(e) injecting the pressurized fluid through the injector stab into the pressure chamber on a second side of the pressure barrier while the valve member is in the open position to delay a return of the valve member back to the closed position; then

(f) venting the pressurized fluid from the second side of the pressure barrier as the valve member returns to the closed position.

16. The method of claim 15, wherein step (c) occurs continuously, regardless of the position of the valve member.

17. The method of claim 15, wherein step (e) occurs in response to movement of the valve member from the closed position.

18. The method of claim 15, wherein step (f) occurs in response to movement of the valve member from the open position toward the closed position.